Mount Kemble Lake

2022 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.
Morristown, NJ

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Tawnya Kabnick
Mount Kemble Lake Association
3 Trails End
Morristown, NJ 07960

YEAR END SUMMARY
2022 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

INTRODUCTION

The following report is the 2022 Year-End Summary of the Lake Management Water Quality Monitoring Program for Mount Kemble Lake located in Morristown, New Jersey. This report includes the details of lake surveys, water quality monitoring program, phytoplankton surveys, and observations logged during visits to the lake throughout the season. Recommendations for Mount Kemble Lake management efforts are also included for lake management strategies in the 2023 season. The Appendix of this report includes graphs and tables of field data, reference guides, along with supporting documents for this report.

The Lake Management Program for Mount Kemble Lake focused on control of nuisance and invasive aquatic plant growth, most specifically curly-leaf pondweed (*Potamogeton crispus),* leafy pondweed (*Potamogeton foliosus*), and southern naiad (*Najas guadalupensis*) for the duration of the season. A total of four (4) different aquatic macrophytes were reported during surveys of the lake (Table 1), with invasive species highlighted in red. One (1) of these species duckweed (*Lemna minor*) is a floating aquatic plant. Also observed during portions of the season, was the growth of planktonic algae in the water column, which would often reduce water clarity.

Scientific Name	Common Name
Potamogeton foliosus	Leafy Pondweed
Potamogeton crispus	Curly-leaf Pondweed
Lemna minor	Small Duckweed
Najas guadalupensis	Southern Naiad

Table 1. 2022 Observed Aquatic Macrophytes.

Weather Discussion

The 2022 weather posed a unique lake management challenge over the course of the season as the overall trend was that it was a warmer than normal year especially during the peak of the management season. Warm weather towards the end of February and early March led to and increase plant and algae growth that was then slowed by a cooler April. Overall, the summer season was the 4th warmest on record and included the warmest average temperature ever recorded for the month of August. Warm temperatures led to warm water, which in some cases led to excessive plant and algae growth. (Figure 1 Rutgers Climate Lab). Precipitation throughout the 2022 season was below average nearly every month with exceptions of April, May, & October. The summer was the 4th driest on record and in some areas many of the trees lost their leaves in August due to lack of rainfall. In terms of lakes, the effects were different depending on waterbodies. Nearly every waterbody dropped several inches and some several feet from normal levels. Despite this, many waterbodies did not grow large amounts of plants or algae likely due to a lack of nutrients running in during rainfall events. Other waterbodies; however, had an increase in aquatic plant and algae growth as low water levels led to more shallow areas and warmer water temperatures. (Figure 2 Rutgers Climate Lab).

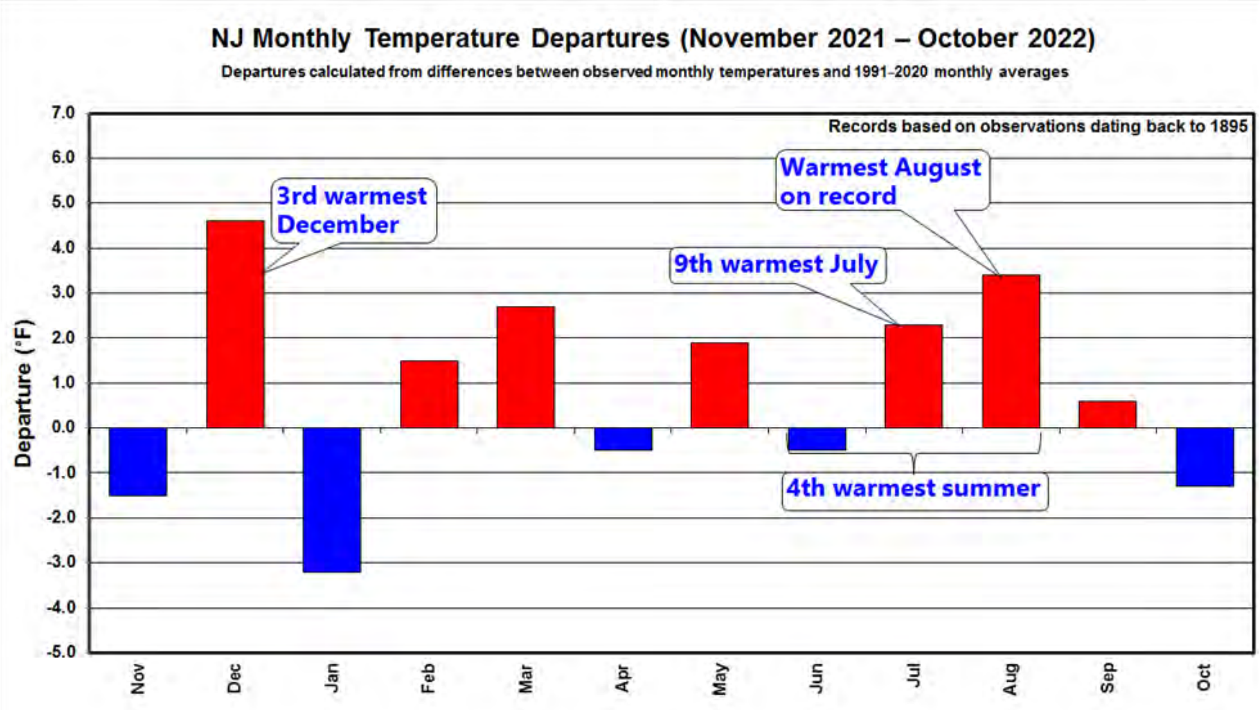


Figure 1: Temperature Departures.

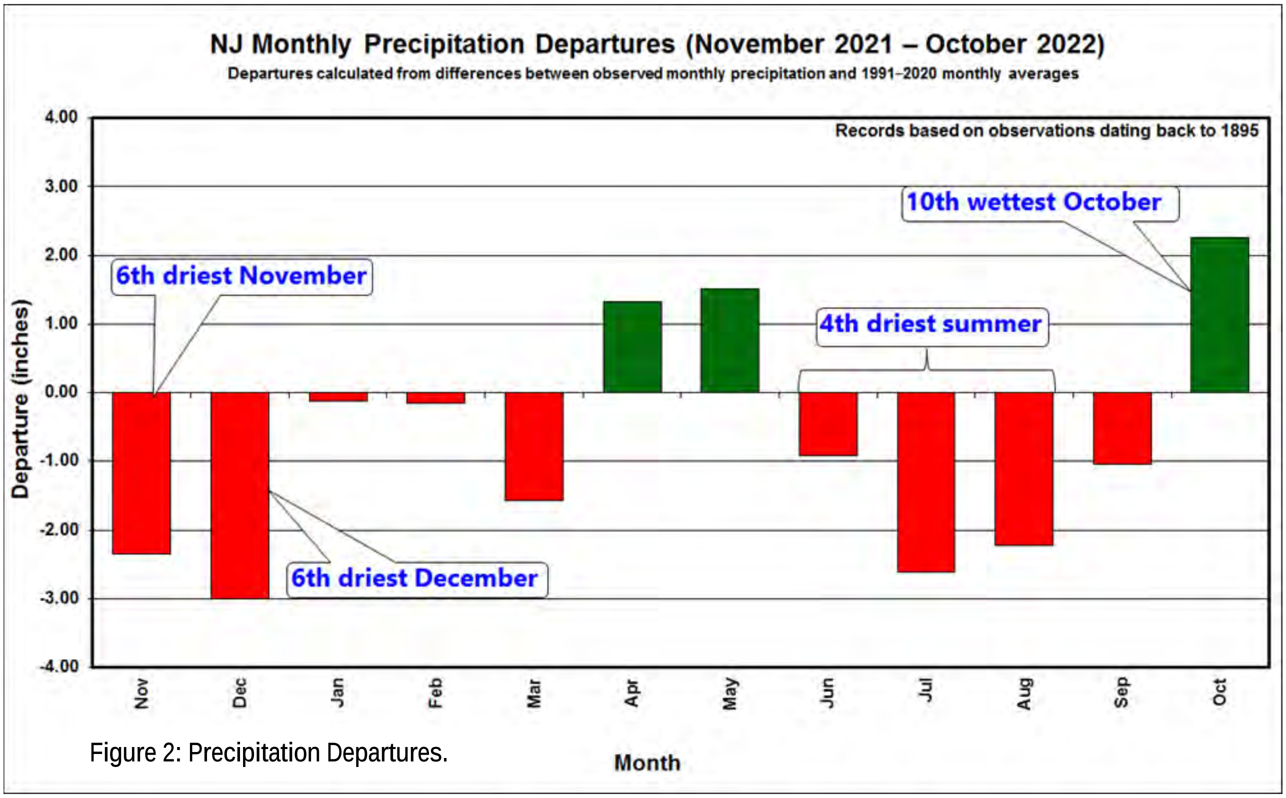


Figure 2: Precipitation Departures.

Lake Management

Aquatic biologists surveyed Mount Kemble Lake on nine (9) dates from April through September to conduct on-water assessments of aquatic vegetation and algae growth, and to perform *in situ* water quality analysis. On three (3) of the nine (9) visits, comprehensive water quality analysis was conducted including, sampling for planktonic algae and zooplankton, lab sample collection and lake profile analysis for temperature and dissolved oxygen. Upon completion of each survey, biologists would review lake conditions to if treatments were necessary. Throughout the season, SŌLitude Lake Management field staff conducted herbicide or algaecide applications for control of nuisance and invasive aquatic vegetation growth during three (3) of the total visits. One (1) treatment was conducted in the clubhouse pond for algae and plant control. The table on the following page provides a reference to indicate dates of applications, what aquatic pesticides were applied, and the target acreage and aquatic plant species for each date (Table 2).

Date	Service Performed	Acres Treated	Target Species
5/19/2022	Aquastrike	3.1	Curly-leaf Pondweed
5/20/2022	Aluminum Sulfate	11	Nutrients
6/13/2022	Copper Sulfate	6.5	Unicellular algae
7/27/2022	Copper Sulfate	6.5	Unicellular algae

Table 2: Mount Kemble Lake 2022 Treatment Log

Throughout the course of the season three (3) treatments were performed. The first treatment was conducted on May 19th as there was shoreline growth of curly-leaf pondweed (*P. crispus*) **Aquastrike** was applied to reduce the reported plant growth. In June, observations reported a reduction in plant growth following the treatment as only a few viable stems were located. At this time there was in increase in unicellular algae growth in the water column. **Copper Sulfate** was employed to reduce the overall growth of unicellular algae. At the end of July, the warmer weather led to an increase in unicellular algae once again resulting in the need for a treatment. **Copper Sulfate** was used in controlling the growth of unicellular algae. Following treatment favorable conditions continued for the remainder of the season as the observations of the lake reported minimal plant or algae growth.

Water Quality Monitoring Program

In 2022, the water quality monitoring program included *in-situ* field measured limnological analysis including temperature/dissolved oxygen profiles, pH, transparency, alkalinity, and total hardness. In addition, surface water chemistry samples were collected at the north inlet and lake station, as well as from the lake bottom at the lake station site, and transported to Alpha Laboratories (Mahwah, New Jersey) for analysis of the following parameters: ammonia, conductivity, nitrate, total phosphorus, and total suspended solids. Collection for phytoplankton and zooplankton identification and enumeration was also performed on three dates. Provided in the Appendix is a short description of each water quality parameter, and laboratory data results. Below is the water quality data tabulated to provide a seasonal reference.

Water Quality Data Tables

Mount Kemble Lake Water Quality Results- Surface					
Parameter	**Units**	**4/26/22**	**6/27/22**	**8/11/22**	**Limits**
Temperature	ºC	13.0	24.60	28.4	**>30˚C**
Dissolved Oxygen	mg/L	12.2	8.37	7.79	**<4.0 mg/L**
pH	SU	8.0	8.00	8.0	**>10 SU**
Alkalinity	mg/L	84	72	88	**>200 mg/L**
Total Hardness	mg/L	**280**	140	140	**>200 mg/L**
Secchi	feet	7.0	10.0	8.0	**<3.0 feet**
Ammonia	mg/L	0.154	ND	0.086	**>0.3 mg/L**
Nitrate	mg/L	**0.837**	0.404	ND	**>0.5 mg/L**
Conductivity	umhos/cm	360	330	340	**>1500 umhos/cm**
Total Suspended Solids	mg/L	ND	ND	ND	**>25 mg/L**
Total Phosphorus	mg/L	0.027	0.016	0.026	**>0.03 mg/L**

Table 3. 2022 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mount Kemble Lake Water Quality Results- Bottom					
Parameter	**Units**	**4/26/22**	**6/27/22**	**8/11/22**	**Limits**
Temperature	ºC	7.1	7.5	8.4	**>30˚C**
Dissolved Oxygen	mg/L	3.3	**0.23**	**0.28**	**<4.0 mg/L**
pH	SU	7.5	8.00	7.0	**>10 SU**
Alkalinity	mg/L	86	88	124	**>200 mg/L**
Total Hardness	mg/L	160	140	160	**>200 mg/L**
Secchi	mg/L	--	---	---	**<3.0 feet**
Ammonia	Mg/L	0.125	**0.419**	**3.32**	**>0.3 mg/L**
Nitrate	mg/L	**0.574**	0.312	ND	**>0.5 mg/L**
Conductivity	umhos/cm	400	250	420	**>1500 umhos/cm**
Total Suspended Solids	mg/L	ND	5.1	21	**>25 mg/L**
Total Phosphorus	Mg/L	**0.034**	**0.036**	**0.165**	**>0.03 mg/L**

Table 4. 2022 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site A					
Parameter	**Units**	**4/26/22**	**6/27/22**	**8/11/22**	**Limits**
Total Phosphorous	mg/L	0.030	0.022	0.024	0.03

Table 5. 2022 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site B					
Parameter	**Units**	**4/26/22**	**6/27/22**	**8/11/22**	**Limits**
Total Phosphorous	mg/L	0.023	0.03	0.099	0.03

Table 6. 2022 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site C					
Parameter	**Units**	**4/26/22**	**6/27/22**	**8/11/22**	**Limits**
Total Phosphorous	mg/L	0.010	0.051	0.051	0.03

Table 7. 2022 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site D					
Parameter	**Units**	**4/26/22**	**6/27/22**	**8/11/22**	**Limits**
Total Phosphorous	mg/L	0.010	0.034	0.18	0.03

Table 8. 2022 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results- Inlet Station			
Parameter	**Units**	**4/26/2022**	**Limits**
Total Phosphorous	mg/L	0.029	0.03

Table 9. 2022 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results- Outlet Station			
Parameter	**Units**	**4/26/2022**	**Limits**
Total Phosphorous	mg/L	0.028	0.03

Table 11. 2022 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Water Quality Results Summary

During the 2022 season, the surface water temperature was 13.0° C in April, and by August the temperature had increased to 28.4 ˚C. This follows the typical pattern observed throughout each season. The pH values collected throughout the year were consistent with a small range of 7.0 and 8 between both surface and bottom samples, which falls within the typical range for freshwater lake systems. The hardness levels were similar to last year, ranging from 140 mg/L to 160 mg/L. Typically there The typical range characteristics to freshwater lakes are those falling between 4 and 200mg/L, which falls in line with typical readings for the lake. Only one reading was outside of this range in the early season as a hardness of 280 mg/L was reported at the surface station.

The chemical composition of Mt. Kemble Lake's surface water is considered moderately hard water. The alkalinity values remained consistent throughout the year from 72 to 124 mg/L, and within a comparable level compared to similar NJ freshwater lakes' chemical composition. These numbers were similar to what was observed in previous years. Conductivity was consistent throughout the season with values ranging from 230 to 420 µmhos/cm., with the highest observed value obtained in the August bottom lake station location sample. These conductivity readings would be considered relatively stable as there was not much fluctuation throughout the season.

Ammonia and nitrates are nutrients based on the chemical composition of nitrogen. These naturally occurring compounds when influenced by human activity can cause excessive plant and algae growth. Throughout the season, in most locations, ammonia levels were within the acceptable limits, but levels were increased in all sampling stations on the bottom as would be expected. The surface levels were all below the acceptable limits. Nitrates were found to be elevated in the early season sampling at both the bottom and surface locations. The rest of the season fell within the acceptable limits likely due to the fact that the nutrients were being used for plant and algae growth in the lake at that time.

Total phosphorus is usually present in freshwater lakes at low concentrations. Total phosphorus concentrations in a freshwater lake system should be less than 0.03 mg/L to prevent higher productivity. In 2021, both the June and August samples were elevated, while only the June bottom sample was elevated.

The four (4) upstream samples were high for the June and August samplings at almost all locations after all starting the season with relatively low readings. Both the inlet and outlet sampling locations were below the acceptable threshold for phosphorus. In the lake itself, the surface readings for phosphorus were all below the acceptable threshold, which typically is not observed throughout the season. The bottom station was elevated, but not significantly as it has been in the past. The lake of rainfall this season might offer some explanation as to the lower readings as heavy rains often was in more nutrients.

Oligotrophic <0.012mg/L Very Good	Mesotrophic 0.012 - 0.024mg/L Good	Eutrophic 0.025 - 0.096mg/L Fair	Hypereutrophic >0.096mg/L Impoundments

Table 11: Trophic Status Based on Phosphorus Values

Transparency (water clarity) displayed a continuous decrease as the season with the observed secchi readings at over 10 feet in the beginning of the season. Mt. Kemble Lake typically supports lake conditions that favor relatively high water clarity readings and even though readings decreased throughout the year the lowest recording was 7 feet with is still considered good. Two (2) unicellular algae treatments were performed, which were likely helpful in maintaining high water clarity throughout the season. Total suspended solids were all below the thresholds throughout the season for Mt. Kemble Lake.

Lake Profile Description

	4/26/2022		6/27/2022		8/11/2022	
Depth (ft)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
Surface	13.90	12.20	25.0	8.60	28.40	7.79
2	13.80	12.30	24.60	8.37	28.80	7.14
4	13.80	12.10	24.80	8.38	28.20	5.90
6	12.80	12.70	22.20	8.77	25.60	0.65
8	10.70	13.50	20.00	2.41	20.40	0.46
10	9.70	9.60	17.80	1.00	14.20	0.40
12	9.10	8.80	14.00	0.55	10.80	0.39
14	8.50	6.90	12.20	0.48	9.60	0.38
16	7.50	4.80	10.30	0.20	9.00	0.37
18	7.20	4.10	8.90	0.15	8.70	0.35
20	7.10	3.30	8.40	0.12	8.30	0.32
22	6.90	3.00	7.90	0.09	8.00	0.32
24	6.80	1.90	7.70	0.08	8.10	0.29
26	6.60	1.10	7.50	0.06	8.40	0.28

Table 12. 2022 Mt. Kemble Lake Profiles

The April profile revealed a well mixed water column, with favorable dissolved oxygen to a depth of 14 feet, which is something that would be expected for that time of the year as water temperatures are colder and allow the water to hold a higher concentration of oxygen. During June, the lake profile was much different from the April reading as the water was much warmer and there was only favorable oxygen levels down to four feet. At that time water temperatures were starting to rise, but were still relatively cool likely leading to the readings. In August, the water temperatures continued to warm and favorable oxygen levels only went down to four feet. During the summer months the lake experienced what is called a positive heterograde curve, which simply means that the water quality conditions of the lake depleted dissolved oxygen below a depth of approximately twelve feet (in this case, this occurred at a depth of only four-six feet). This type of water quality condition is observed most frequently in lakes where the surface area is small relative to the maximum depth and protected from intense wind action by surrounding topography and vegetation, which is descriptive of Mt. Kemble Lake. Complete profile graphs are provided in the Appendix of this report.

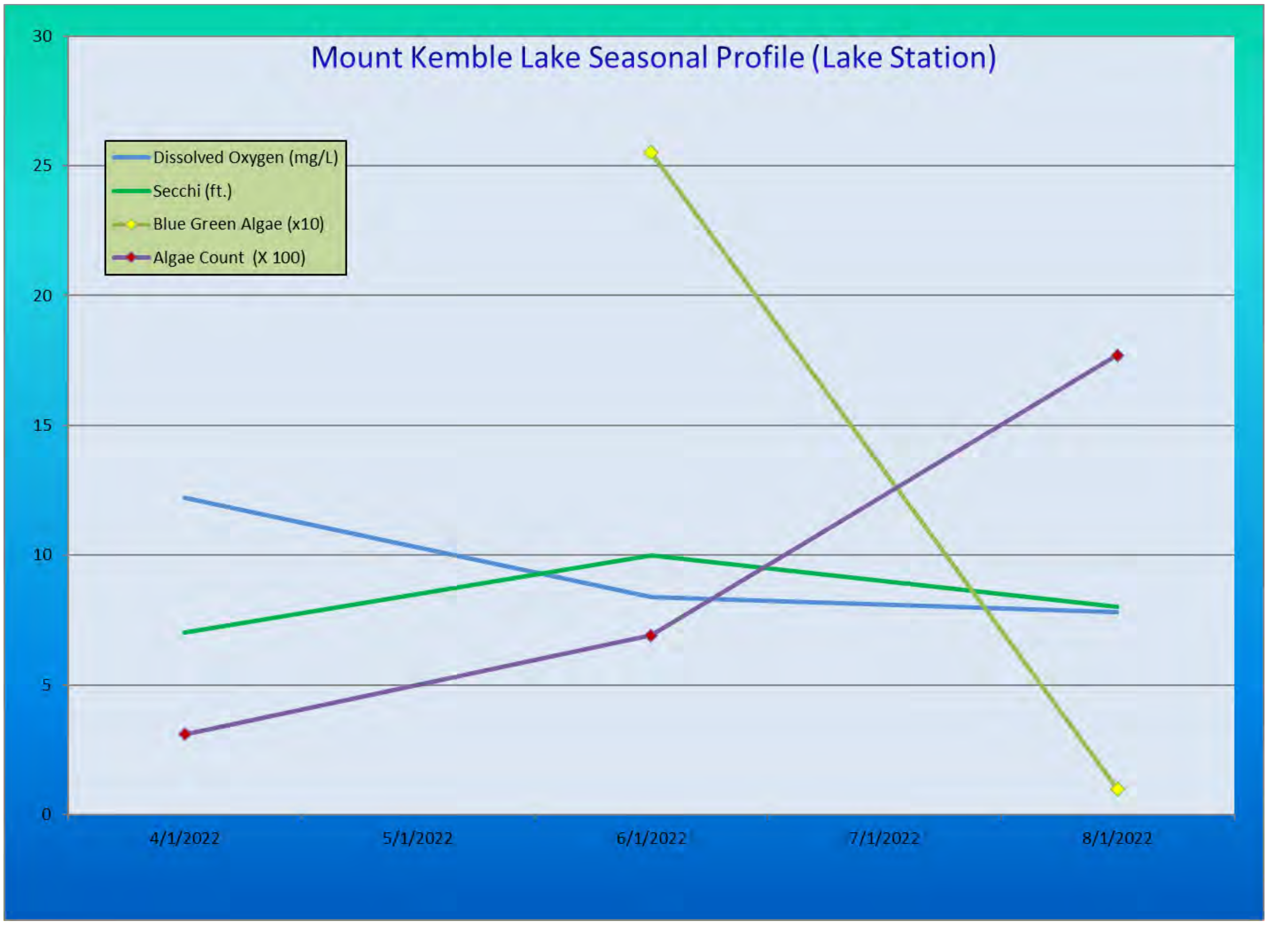


Figure 3. Mount Kemble Lake Seasonal Profile

Plankton Surveys

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2021, surface phytoplankton samples were collected at two established water quality monitoring sites in April, June, and August. Samples were collected in dedicated, pre-rinsed one-liter plastic bottles and placed in a cooler with ice for transport. The samples were identified and enumerated under a compound microscope immediately upon return to SŌLitude Lake Managements' laboratory. The microscopic examination data sheets and graphs are provided in the Appendix. A single vertical zooplankton tow was conducted at the lake station on each date. The collected sample was preserved in the field and returned to SŌLitude's lab for analysis.

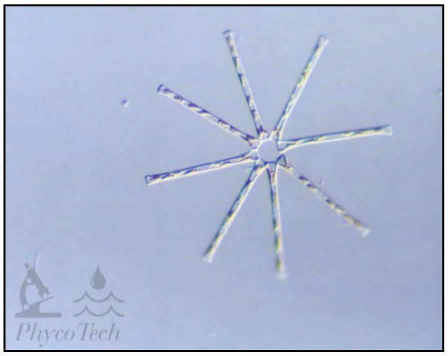
A Phytoplankton Primer

Lakes typically contain three broad categories of phytoplankton (also sometimes referred to as algae). These include filamentous phytoplankton, macroscopic multi-branched phytoplankton (which appear similar to submersed plants), and unicellular phytoplankton. Each category shall be discussed in turn, although the results of the season's sampling will focus on the unicellular phytoplankton population.

Filamentous phytoplankton are typically macroscopic (that is, visible with the naked eye), composed of long chains of cells that are attached to a substrate, typically the lake bottom, submersed or emergent vegetation, or rocks. This is called benthic filamentous algae (BFA), and rampant growth can become visible at the surface. As pieces of benthic filamentous algae break apart, it often floats on the surface as dense unsightly mats called floating filamentous algae (FFA). Typically, genera of green algae or blue-green algae develop into nuisance filamentous mats. Abundant nuisance growth of filamentous phytoplankton creates numerous negative impacts to a lake. These can include a decrease in aesthetics, a decrease in recreational uses, increased fishing frustration, and water quality degradation.

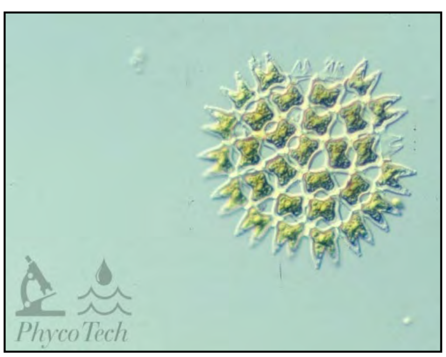
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches, under ideal conditions, this type of phytoplankton can reach lengths of several feet, and create a dense carpet on the bottom of a lake. Therefore, it typically does not reach nuisance levels in a lake, save for high use areas such as beaches and other popular swim areas. Since this phytoplankton occupies a similar ecological niche as submersed plants, it's often included in detailed and visual aquatic plant surveys. It provides numerous benefits to a lake system, including sediment stabilization, acting as a nutrient sink, providing invertebrate and fish shelter and habitat, and is one of the first to re-colonize a disturbed area. In the Northeast, muskgrass (*Chara* sp.) and stonewort (*Nitella* sp.) are two of the most common macroscopic multi-branched phytoplankton.

Unicellular phytoplankton are typically microscopic, and consist of individual cells or colonies of cells suspended in the water column. At high enough densities (often called a bloom), they can impart a green or brown (and sometimes, even red) tint to the water column. Unicellular phytoplankton belongs to several taxonomic groups with density and diversity of these groups often varying due to seasonality. When unicellular phytoplankton density becomes elevated it can reduce water clarity (giving the water a "pea soup" appearance), and impart undesirable odors. Usually blue-green algae are responsible for these odors, but other groups or extremely elevated densities can impart them as well. In addition to decreased aesthetics, unicellular phytoplankton blooms can cause degradation of water quality, increase the water temperature (turbid water warms faster than clear water), and can possibly produce a variety of toxins (in the case of blue-green algae), depending on the type of genera present and environmental conditions. Numerous groups of unicellular phytoplankton are common in the Northeast, including diatoms, golden algae, green algae, blue-green algae, euglenoids and dinoflagellates. Each group shall be discussed in turn.

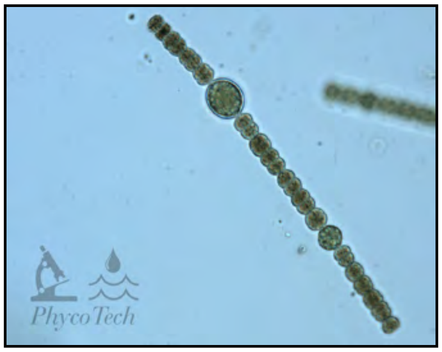


Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population characteristics of diatoms. Some are round and cylindrical (centric) in shape, while others are long and wing-shaped (pennales). They are usually brown in color, and reach maximum abundance in colder or acidic water. Therefore, they tend to dominate in winter and early spring. Common diatoms in the Northeast include *Fragilaria*, *Cyclotella*, *Navicula*, and *Asterionella* (pictured).

Golden Algae are typically yellow or light brown in color. Cell size is usually small oval shaped with a partially empty area, but several genera create colonies of smaller cells. Most have two flagella, and some type of scales or a rigid coating that grants it a fuzzy appearance. However, a few filamentous forms are possible as well. They typically prefer cooler water, so they dominate in the late fall, winter, or early spring. They also tend to bloom at deeper (cooler) depths. They are common in low nutrient water, and numerous forms produce taste and odor compounds. Common golden algae in the Northeast include *Dinobryon* (pictured), *Mallomonas*, and *Synura*.

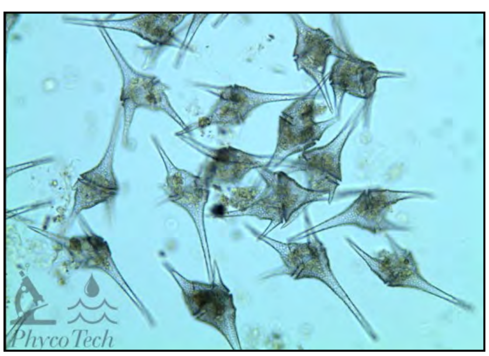


Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically with distinct cell shapes light green in color. Some prefer acidic waters, and others highly eutrophic (sewage) conditions. A green algae bloom usually occurs in water with high nitrogen levels. Green algae typically dominate in mid to late summer in the Northeast. Common genera include *Chlorella, Scenedesmus, Spirogyra* and *Pediastrum* (pictured).



Cyanobacteria, often referred to as blue-green algae, are ubiquitous, photosynthetic bacteria. They tend to be microscopic, but significant biomass accumulation can result in a Harmful Cyanobacterial Bloom (HCBs) that are visible to the naked eye. Cyanobacteria possess multiple mechanisms conferring a competitive advantage. Structurally, they can have nitrogen-fixing cells that allow them to grow in nutrient-limited conditions and resting cells that allow them to sustain populations. They tend to be encased in a mucilaginous matrix or sheath that protects against cell penetration and desiccation. In addition, they possess antennae-like structures for harvesting incredibly low amounts of incident light, allowing for benthic growth. The production of gas vesicles allows cyanobacteria to regulate their buoyancy to move up and down the water column to obtain nutrients. Cyanobacteria tend to be more abundant in neutral or alkaline, nitrogen-poor waters. Thus, they prefer eutrophic systems with high phosphorus loads. However, cyanobacteria are tolerant of a wide variety of water chemistries and boast many oligotrophic forms as well. Numerous cyanobacteria produce taste and odor compounds, and under certain environmental conditions can produce toxins dangerous to humans, fish, and livestock. Cyanobacteria typically dominate a lake system in late summer to early fall. Common cyanobacteria that occur in the Northeast include *Dolichospermum spp.* (pictured), *Aphanizomenon spp., Microcystis spp.,* and *Coelosphaerium spp.*

Euglenoids are single-celled eukaryotes typically with a primitive eyespot and flagellum or flagella. They are generally green, but some species are red or colorless. Euglenoids are often associated with quiescent, eutrophic waters containing high concentrations of organic matter. Common euglenoids that occur in the Northeast include *Euglena spp.* (pictured), *Phacus spp.*, and *Trachelomonas spp*.



Dinoflagellates are a monophyletic group strongly associated with marine environments, in which they often cause toxic HABs known as Red Tide. However, toxin production in freshwater genera is very rare. Dinoflagellates are generally larger in size as compared to other algae. Cells typically present themselves as ovoid or spherical in shape and are encompassed in cellulose plates known as armor. They usually possess two flagella which confers propulsion and rotation through the water column. Dinoflagellates generally prefer organic-rich or acidic waters and can impart a coffee-like brown tint to the water when enough biomass has accumulated. Common dinoflagellates in the Northeast include *Ceratium spp.* (pictured) and *Peridinium spp.*

PHYTOPLANKTON RESULTS

In April, the phytoplankton density was considered light and favorable at the inlet station and moderate at the lake station. Diversity would also be considered moderate at both locations with eight (8) generas observed at each station. Diatoms accounted for the majority of both samples; however, the most dominant generas were golden algae. *Mallomonas* was most dominant at the inlet station, while *Synura* was most dominant at the lake station. The second sampling occurred in late June and at the time both stations were supporting moderate density algae growth. Diversity had increased slightly to ten (10) generas at the inlet station and to (9) generas at the lake station, which would be considered moderate to high. The most commonly observed generas was cyanobacteria, *Anabaena* was most commonly found at the inlet station, while the lake station was sample consisted mostly of *Aphanizomeon*.

Algal Group			
% Abundance	4/26/22	6/27/22	8/11/22
Diatoms	**41.6%**	9.6%	**55.8%**
Golden Algae	37.5%	1.2%	27.9%
Protozoa			
Green Algae	20.9%	**43.4%**	10.5%
Cyanobacteria		37.3%	0.6%
Dinoflagellates		8.5%	4.6%
Euglenoids			0.6%
Total Orgs / mL	**240**	**830**	**1720**

Table 13. Mt. Kemble Phytoplankton Assemblage Inlet

Algal Group			
% Abundance	4/26/22	6/27/22	8/11/22
Diatoms	21.1%	7.4%	**48.4%**
Golden Algae	**60.5%**		23.6%
Protozoa			
Green Algae	18.4%	33.3%	23.6%
Cyanobacteria		**37.3%**	
Dinoflagellates		22.0%	4.4%
Euglenoids			
Total Orgs. / mL	**380**	**540**	**1820**

Table 14. Mt. Kemble Phytoplankton Assemblage Lake Station

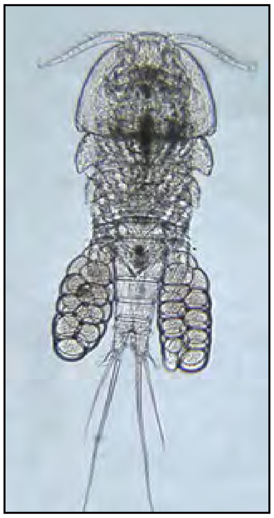
For the August sampling event, the phytoplankton density increased at both locations to be considered high at both locations as this sampling event was the highest of the season. The inlet station saw diversity increase again to twelve (12) generas, while the diversity remained the same at the lake station sampling location with nine (9) observed generas. The late season sampling reported a relatively diverse group of algae with diatoms comprising roughly half of the total sample. *Synedra* was the most common genera reported during the final sampling event of the season. Overall, planktonic algae was relatively low and manageable throughout the season with a slight increase towards the end.

A Zooplankton Primer

Zooplankton provides an important link in a typical lake's food web between phytoplankton and developing/juvenile stages of fish. In general, zooplankton feed on phytoplankton, while fish in turn feed on zooplankton. The rate of phytoplankton feeding efficiency is primarily based on body size, but zooplankton group, and to some effect specific genera, also plays an important role. There are three main groups of zooplankton found in freshwater systems: rotifers, cladocera, and copepods.

Rotifers are a diverse group of zooplankton, very common in lakes and marine environments alike. Rotifers are generally the smallest zooplankton of the three groups, and thus typically the least efficient phytoplankton grazers. Feeding preferences are determined primarily by mouth structures, and include generalist feeders (omnivores), which eat any small organic detritus encountered, and predators, which eat other smaller rotifers and small phytoplankton. Generalist feeders include *Filinia, Keratella, Lecane, Euchlanis,* and *Brachionus*. Predator genera include *Polyarthra* (larger species), *Asplanchna, Synchaeta*, and *Trichocerca*.

Cladocera are less diverse, but also very common in freshwater lakes. They are sometimes called "water fleas". They spend most of their lifecycle reproducing via parthenogenesis (asexual reproduction with an all female population) only switching to less efficient sexual reproduction when environmental conditions decline. Some genera (such as *Daphnia*) can be quite large (up to 5.0 mm long, visible without magnification), and thus can be classified as highly efficient phytoplankton grazers. Most cladocera are phytoplankton grazers, although their diet includes most organic matter ingested, including bacteria and protozoa. Body size (and thus mouth size) determines feeding efficiency, but ironically the larger-bodied genera are easier to see by predaceous fish, and thus typically have reduced numbers in populations of zooplanktivorous fish. *Daphnia* are the most efficient phytoplankton feeders, while *Ceriodaphnia*, *Bosmina* and *Eubosmina* are less efficient. There are a few predator genera as well, including *Polyphemus* and *Leptodora*.



Copepods are almost excusive to freshwater lake systems (not streams or rivers) and estuarine and marine systems. Of the six suborders native to the United States, three are parasitic, and three are free living. One of the free living, *Harpacticoida* are exclusively benthic and thus often not collected in traditional plankton tows (unless the bottom sediments are disturbed). The remaining two suborders, the Calanoida and the Cyclopoida are of primary concern during lake studies. All copepods have several naupilar stages, followed by several immature stages, before reaching an adult stage. Both suborder adults are considered large bodied zooplankton, but have distinct feeding preferences. Calanoids are almost exclusively phytoplankton feeders and have even demonstrated selective feeding strategies. Cyclopoids have mouth parts suitable for biting and seizing prey. Their diet is primarily other crustacean zooplankton (including cannibalism on younger life stages), as well as phytoplankton and organic detritus ingestion, but less efficiently.

Zooplankton samples were collected with an 80 um Nitex plankton net. At the Lake Station, a single vertical tow was performed to a depth of 18 feet. Using as little site water as possible, the sides of the net were rinsed of any trapped zooplankton, concentrating the organisms into the net bottom. This concentrate was then emptied into a clean 1000 mL HDPE sample bottle. Immediately after collection, the sample was preserved with an equal amount of 10% sucrose formalin, to achieve a 5% solution. Sucrose was added to the preservative to help maintain carapace integrity. The samples were then placed in a cooler stocked with blue ice. On arrival at SŌLitude's laboratory, the samples were stored in a dark refrigerator until the samples were identified and enumerated.

In the laboratory, each sample was manually mixed for about one minute, before a one mL subsample was removed using a calibrated syringe. The subsample was placed on a Sedgewick-Rafter counting cell, and examined under a compound microscope at 100X magnification. By using calibrated guides on the microscope stage, the entire one mL sample was examined, and any zooplankton were identified and enumerated to the lowest practical taxa using regionally appropriate taxonomic keys. This procedure was repeated two more times to generate three replicate counts. The counts were then averaged, and back-calculated to achieve an organism per liter density. The zooplankton count data sheets in the Appendix describe the step by step procedures for all three replicates, and the final averaged densities. Also, included in the Appendix are pie charts depicting the sample date zooplankton group distribution.

2022 Zooplankton Results

Zooplankton Group	4/26/2022	6/27/2022	8/11/2022
Rotifers	**48.8%**	**47.1%**	**59.7%**
Cladocera	33.9%	18.6%	4.7%
Copepoda	17.3%	34.3%	35.6%
Total Zooplankton (Orgs. / mL)	5621	1538	6228

Table 16. Mount Kemble Lake 2022 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 5621 organisms per milliliter, which is considered high as well as sample diversity with thirteen (13) different genera observed. At this time Rotifers accounted for approximately half of the total sample at 48.8% of the total zooplankton community with *Asplanchna* being the most abundant genera. Additionally, a moderate density of Cladocerans and Copepoda were observed as they accounted for just under half of the sample combined.

The June sampling reported a decrease in density of zooplankton as there were 1538 organisms per milliliter. The Rotifer genera were the most commonly found accounting for nearly half of the total sample at 47.1% of the total with the genera *Keratella* being the most commonly found within the group. At this time zooplankton diversity is considered high as a total of eleven (11) different genera were found in the sample. Copepoda and Cladocera accounted for slightly over half of the total sample.

The final sampling of the season showed that the zooplankton composition was considered moderate as nine (9) different genera were observed. The density of zooplankton observed was the highest of the season with a total of 6228 orgs/mL. Rotifers made up 59.7% of the zooplankton composition with *Asplanchna* being the most abundant in the sample. The Cladocerans made up a very small portion of the of the total sample at 4.7%. Over a quarter of the total sample was Copepoda as it accounted for 35.6% of the organisms observed. Overall, rotifers dominate the zooplankton community in Mt. Kemble Lake.

Discussion

The 2022 management program of Mount Kemble Lake will continue to focus on the control of nuisance densities of plant and algae growth. The target aquatic macrophyte species observed at Mount Kemble Lake in 2022, curly-leaf pondweed (*P. crispus*) and occasionally southern naiad (*N. guadalupensis*) depending on the conditions during that season. Throughout the season plant growth was similar to what was observed the previous year as only one (1) treatment was necessary to provide season long control.

Aquastrike should continue to be utilized through the season for its ability to selectively control nuisance submerged vegetation by rapid absorption into the target plant and ability to be effective in shallow regions of the lake. **Red Eagle/Clipper** (flumioxazin) can also be utilized a method of control, especially for smaller target areas as it can provide control in areas that are heavily disturbed. In addition, it is beneficial to allow certain amounts of plants to persist in the lake to provide dissolved oxygen, fish habitat, and compete for nutrients required for nuisance plant and algae development. The growth of leafy pondweed and southern naiad should be encouraged in areas of the lake where they are not interrupting recreational activities or reducing the aesthetic appeal of the lake.

Copper sulfate will continue to provide the most a cost-effective management method for controlling nuisance density filamentous and planktonic algae growth. **Copper Sulfate** has acknowledged negative impacts on zooplankton populations, with localized targeted applications recommended for only nuisance growth of filamentous algae, and limited use on planktonic algae blooms only at times when water clarity is significantly impaired. In 2022, two (2) **Copper Sulfate** treatments were conducted as growth of unicellular algae was reducing the water clarity slightly. Numerous other copper and non-copper based algaecides are available and at the request of the Association, SŌLitude Lake Management would be happy to discuss these alternatives. **Cutrine Plus** is an effective way to control these planktonic blooms as it remains suspended in the water column longer than **Copper Sulfate** and is something to be considered.

The management program for 2022 is anticipated to be similar to the monitoring program that was utilized this year, which included at least twice per month lake surveys during the height of the growing season, including lake-wide assessment of the submersed aquatic plant community. The water clarity was at considered good throughout the season, however, algae counts were elevated on one (1) of the three (3) sampling events and treatments were conducted in between those samplings for algae. Alum was applied this season and can likely be a contributing factor to the lower phosphorus levels reported throughout the season. The reduction in overall phosphorus will lead to less plant and algae growth as it is the limiting resource in all aquatic habitats. Continued monitoring of the inlet pond will help to understand the amount of phosphorus that is entering Mt. Kemble Lake and management strategies can be designed using that information. It is also recommended to continue to perform phosphorus mitigation in the upstream pond to manage phosphorous concentrations closer to the source of the phosphorous introduction which will help reduce the concentration that is entering the lake.

The current Mount Kemble Lake Water Quality Monitoring Program is well-designed, and provides suitable water quality data allowing for proactive management of the lakes' environment and reduces the opportunity for the development of problematic situations. It is important to continue water quality monitoring on a regular yearly basis over the long-term to build a baseline data record which will assist biologists in developing more quantitative analysis for greatest possible management procedures.

SŌLitude Lake Management appreciates the opportunity to be of service to the Mount Kemble Lake Association and looks forward to assisting the Association on the stewardship of Mount Kemble Lake in the 2023 lake management season.

Sincerely,

Carl Cummins

Carl Cummins
Environmental Scientist

SŌLITUDE
LAKE MANAGEMENT

APPENDIX

Appendix A: Water Quality Parameter Descriptions

Temperature

Temperature is measured in degrees Celsius, and is very important to aquatic biota. Several factors affect temperature in a lake system, including air temperature, season, wind, water flow through the system, and shade trees. Turbidity can also increase water temperature as suspended particles absorb sun rays more efficiently. Water depth also affects temperature. In general, deeper water remains cooler during the summer months.

Temperature preferences vary among aquatic biota. Since water temperature typically varies between 5 ºC and 30 ºC during the season, most aquatic biota can flourish under this wide range of temperatures. Of more concern is thermal shock, which occurs when temperature rapidly changes in a short amount of time. Some aquatic biota can become stressed when temperature changes as little as 1-2 ºC in a 24 hour period.

Dissolved Oxygen

Dissolved Oxygen is the measurement of the amount of oxygen freely available to aquatic biota in water. Several factors play a role in affecting the amount of dissolved oxygen in the water. These factors include temperature (warmer water holds less dissolved oxygen), low atmospheric pressure (such as higher altitude) decreases the solubility of oxygen, mineral content of the water can reduce the water's dissolved oxygen capacity, and water mixing (via wind, flow over rocks, or thermal upwelling) increases dissolved oxygen in the water. In addition, an over abundance of organic matter, such as dead algae or plants causes rapid aerobic bacteria growth. During this growth, bacteria consume oxygen during respiration, which can cause the water's dissolved oxygen to decrease.

Dissolved oxygen has a wide range, from 0 mg/L to 20 mg/L. To support diverse aquatic biota, 5-6 mg/L is minimally required, but 9-10 mg/L is an indicator of better overall water quality. Dissolved oxygen reading of below 4 mg/L is stressful to most aquatic organisms, especially fish.

Water Clarity

Transparency (or visibility) is measured with a Secchi disc, and can provide an experienced biologist with a quick determination of a lake's water quality. In short, higher visibility indicates a cleaner (and healthier) aquatic system. Cloudy conditions could indicate nutrient rich sediments entering the lake or excessive algal blooms due to nutrient availability, leading to a degradation of water quality.
Clear conditions allow greater light penetration and the establishment of a deeper photic zone. The photic zone is the depth of active photosynthesis carried out by plants and algae. A byproduct of photosynthesis is dissolved oxygen, required for use by higher aquatic organisms, such as zooplankton and fish.

Total Hardness

Hardness is a measure of dissolved salts in the water, usually calcium, but also magnesium and iron. Hardness is usually influenced by the rock and soil types of the watershed, and the amount of runoff over these surfaces. Hardness can be measured for only calcium content (Hardness (Ca)), or for all three salts, called Total Hardness. Water with Hardness (Ca) less than 10 mg/L can only support sparse aquatic biota. Freshwater typically has a Hardness (Ca) level from 4 to 100 mg/L. In general, the degree of total hardness can be classified according to the table to the right.

Alkalinity

Alkalinity is the measure of the water's capacity to neutralize acids. A higher alkalinity can buffer the water against rapid pH changes, which in turn prevents undue stress on aquatic biota due to fluctuating pH levels. The alkalinity of a lake is primarily a function of the watersheds soil and rock composition. Limestone, dolomite and calcite are all a source of alkalinity. High levels of precipitation in a short amount of time can decrease the waters alkalinity. A typical freshwater lake has an alkalinity of 20-200 mg/L. A lake with a low alkalinity typically also has a low pH, which can limit the diversity of aquatic biota.

pH

The measurement of acidity or alkalinity of the water is called pH (the "potential for hydrogen"). Several factors can impact the pH of a lake, including precipitation in a short amount of time, rock and soil composition of the watershed, algal blooms (increase the pH), and aquatic plant decomposition (decreases the pH). A pH level of 6.5 to 7.5 is considered excellent, but most lake systems fall in the range of 6.0 to 8.5. Aquatic biota can become stressed if the pH drops below 6.0, or increases above 8.5 for an extended amount of time.

Most aquatic biota are adapted to specific pH ranges. When the pH fluctuates rapidly, it can cause changes in aquatic biota diversity. Immature stages of aquatic insects and juvenile fish are more sensitive to low pH values than their adult counterparts. Therefore, a low pH can actually inhibit the hatch rate and early development of these organisms.

Conductivity

Conductivity is the measure of water's ability to conduct an electrical current, and is measured in umhos/cm, the higher the number of charged particles(ions) in the water, the easier for electricity to pass through it. Conductivity is useful in lake management by estimating the dissolved ionic matter in the water, the lower the conductivity, the higher the quality of water (oligotrophic). A higher conductivity usually indicates an abundance of plant nutrients (total phosphorous and nitrate), or eutrophic conditions. Industrial discharge, road salt runoff, and septic tank leaching can increase conductivity. Distilled water has a conductivity of 0.5 to 2.0 umhos/cm, while drinking water conductivity typically ranges from 50to 1,500 umhos/cm. Conductivity below 500 umhos/cm is considered ideal in a lake system.

Nitrate

Nitrates are chemical compounds derived from nitrogen and oxygen. Nitrogen is needed by all plants and animals to make proteins needed for growth and reproduction. Nitrates are generated during plant and animal decomposition, from man-made sources, and from livestock and waterfowl sources. Man-made sources of nitrates include septic system leaching, fertilizer runoff, and improperly treated wastewater. Freshwater lake systems can potentially receive large nitrate inputs from waterfowl, specifically large flocks of Canada geese. An increase in nitrate levels can in turn cause an increase in total phosphorous levels. A nitrate level greater than 0.3 mg/L can promote excessive growth of aquatic plants and algae.

Total Phosphorous

Total phosphorous is a chemical compound derived from phosphorous and oxygen. Total phosphorous is usually present in freshwater in low concentrations, and is often the limiting nutrient to aquatic plant growth. However, man-made sources of phosphorous include septic system leaching, fertilizer runoff, and improperly treated wastewater. These phosphorous inputs usually enter a freshwater lake system during rain events, and bank erosion.

A total phosphorous level greater than 0.03 mg/L can promote excessive aquatic plant growth and decomposition, either in the form of algal blooms, or nuisance quantities of aquatic plants. This process is called eutrophication, and when induced or sped up by man-made nutrient inputs, it is called cultural eutrophication. As a result of this excessive growth, recreational activities, such as swimming, boating, and fishing in the lake can be negatively impacted. In addition, aerobic bacteria will thrive under these conditions, causing a decrease in dissolved oxygen levels which can negatively impact aquatic biota such as fish.

Total Suspended Solids

Total suspended solids refer to all of the particulate matter suspended in the water column. When these solids settle to the bottom of a water body (a process called siltation), they become sediments. There are two components that make up total suspended solids: inorganic and organic. The inorganic portion is usually considerably higher than the organic portion and includes silts, clays, and soils. Organic solids include algae, zooplankton, bacteria and organic debris. All these solids create turbid (or “muddy”) conditions. The geology and vegetation of a watershed affect the amount of suspended solids that enter a lake system. Most suspended solids originate from accelerated soil erosion from agricultural operations, logging activities, and construction activities. Another source is the disturbance of bottom sediments from dredging activities, grazing of bottom feeding fish, and recreational activities such as boating.

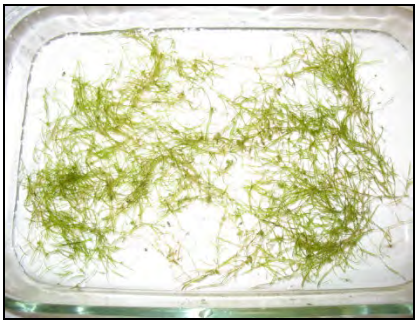
Ammonia

Ammonia is a type of nitrogen compound used by plants and algae to support growth. Ammonia content in a body of water is influenced by decaying plants and animals, animal waste, industrial waste effluent, agricultural runoff, and atmospheric nitrogen gas transfer. A concentration exceeding 0.30 mg/L can promote excessive plant and algae growth. Elevated ammonia levels can increase nitrification, which in turn depletes the oxygen content of water. Extremely high ammonia levels can be toxic to aquatic biota (such as fish).

APPENDIX B: AQUATIC MACROPHYTE GUIDE

Small Duckweed (*Lemna minor*. Common Names: Small duckweed, water lentil, lesser duckweed. **Native.**). Small duckweed is a free floating plant, with round to oval-shaped leaf bodies typically referred to as fronds. The fronds are small (typically less than 0.5 cm in diameter), and it can occur in large densities that can create a dense mat on the water's surface. Each frond contains three faint nerves, a single root (a characteristic used to distinguish it from other duckweeds), and no stem. Although it can produce flowers, it usually reproduces via budding at at a tremendous rate. Its population can double in three to five days. Since it is free floating, it drifts with the wind or water current, and is often found intermixed with other duckweeds. Since it's not attached to the sediment, it derives nutrients directly from the water, and is often associated with eutrophic conditions. It over winters by producing turions late in the season. Small duckweed is extremely nutritious and can provide up to 90% of the dietary needs for waterfowl. It's also consumed by muskrat, beaver and fish, and dense mats of duckweed can actually inhibit mosquito breeding.

Curly-leaf Pondweed (*Potamogeton crispus*. Common Name: curly-leaf pondweed. **Invasive.**): Curly-leaf pondweed has spaghetti-like stems that often reach the surface by mid-June. Its submersed leaves are oblong, and attached directly to the stem in an alternate pattern. The margins of the leaves are wavy and finely serrated, hence its name. No floating leaves are produced. Curly-leaf pondweed can tolerate turbid water conditions better than most other macrophytes. In late summer, Curly-leaf pondweed enters its summer dormancy stage. It naturally dies off (often creating a sudden loss of habitat and releasing nutrients into the water to fuel algae growth) and produces vegetative buds called turions. These turions germinate when the water gets cooler in the autumn and give way to a winter growth form that allows it to thrive under ice and snow cover, providing habitat for fish and invertebrates.



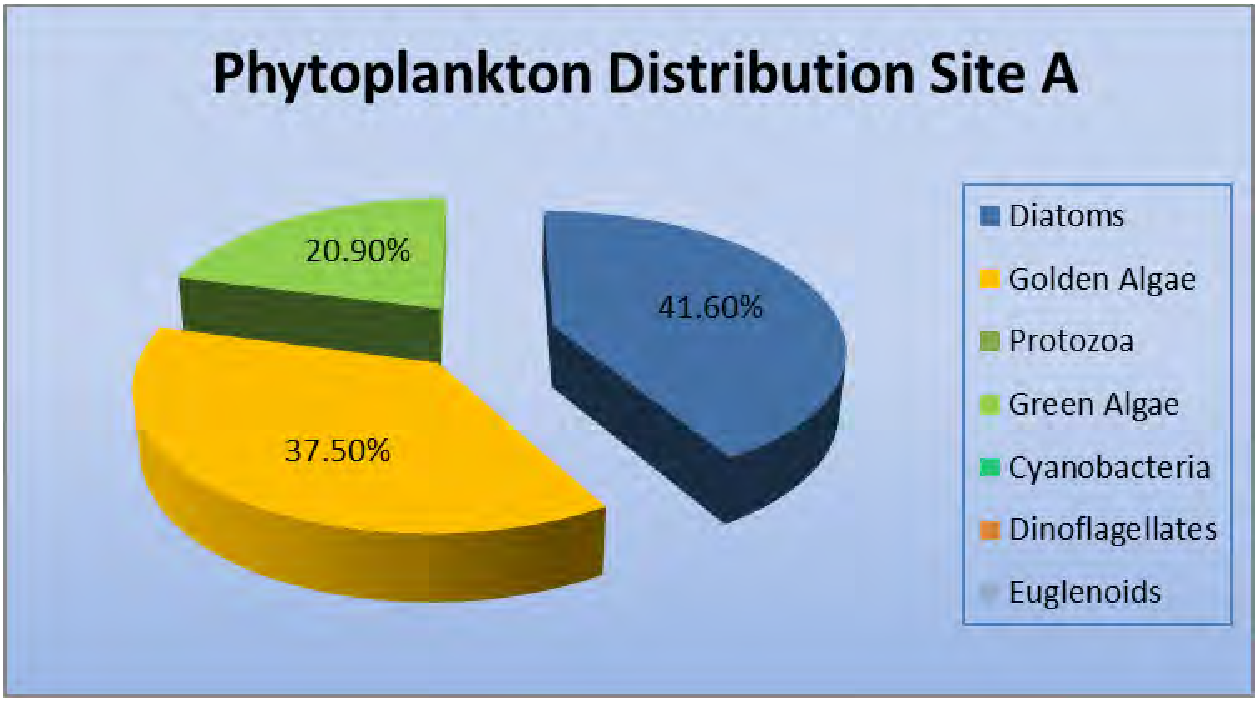
Leafy Pondweed (*Potamogeton foliosus*: Common Name: leafy pondweed. **Native**.): Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly more narrow as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. It produces early season fruits in tight clusters on short stalks in the leaf axils. These early season fruits are often the first grazed upon by waterfowl during the season. Muskrat, beaver, deer and even moose also graze on the fruit. It inhabits a wide range of habitats, but usually prefers shallow water. It has a high tolerance for eutrophic conditions, allowing it to even colonize secondary water treatment ponds.

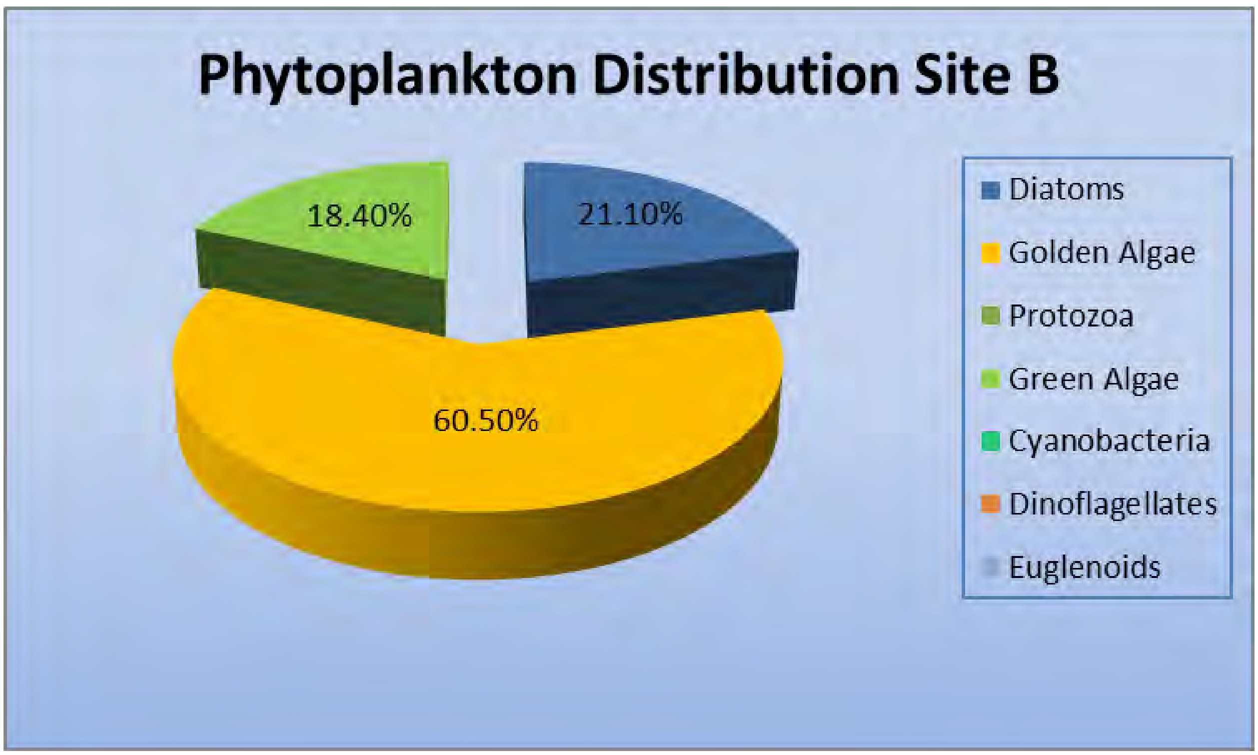
Southern Naiad (*Najas guadalupensis*. Common Names: Southern water nymph, bushy pondweed. **Native**.): Southern naiad is an annual aquatic plant that can form dense stands of rooted vegetation. Its ribbon-like leaves are dark-green to greenish-purple, and are wider and less pointed than slender naiad. Flowers occur at the base of the leaves, but are so small, they usually require magnification to detect. Southern naiad is widely distributed, but is less common than slender naiad in northern zones. Southern naiad reproduces by seeds and fragmentation.

Site A: Inlet Station			Site B: Lake Station			Site C:			Amount Examined: 200mL		
Diatoms	**A**	**B**	**C**	**Green Algae**	**A**	**B**	**C**	**Cyanobacteria**	**A**	**B**	**C**
Asterionella	30	10		*Scenedesmus*	20	20					
Pinnularia	40			*Gloeocystis*	30	50					
Nitzschia	30	60									
Synedra		10									
Golden Algae	**A**	**B**	**C**								
Dinobryon	20	20						**Results**			
Mallomonas	50	60									
Synura	20	150						**Site**	**A**	**B**	**C**
				Euglenoids	**A**	**B**	**C**	**Total Genera**	8	8	
Dinoflagellates	**A**	**B**	**C**					**Water Clarity (ft)**	7.0	7.0	
								Organisms/mL	240	380	

Collection Date: **26 April 2022** **Examination Date:** **27 April 2022**

This is the first sampling event of the 2022 season at Mt Kemble. Algal density is considered low. Algal diversity is considered moderate. The assemblage is dominated by diatoms at the inlet station; low levels of golden algae and green algae are also present. The assemblage at the lake station is dominated by golden algae; low levels of diatoms and green algae are also present. Water clarity is considered good.


Phytoplankton Distribution Site A
20.90%
41.60%
37.50%
Diatoms
Golden Algae
Protozoa
Green Algae
Cyanobacteria
Dinoflagellates
Euglenoids

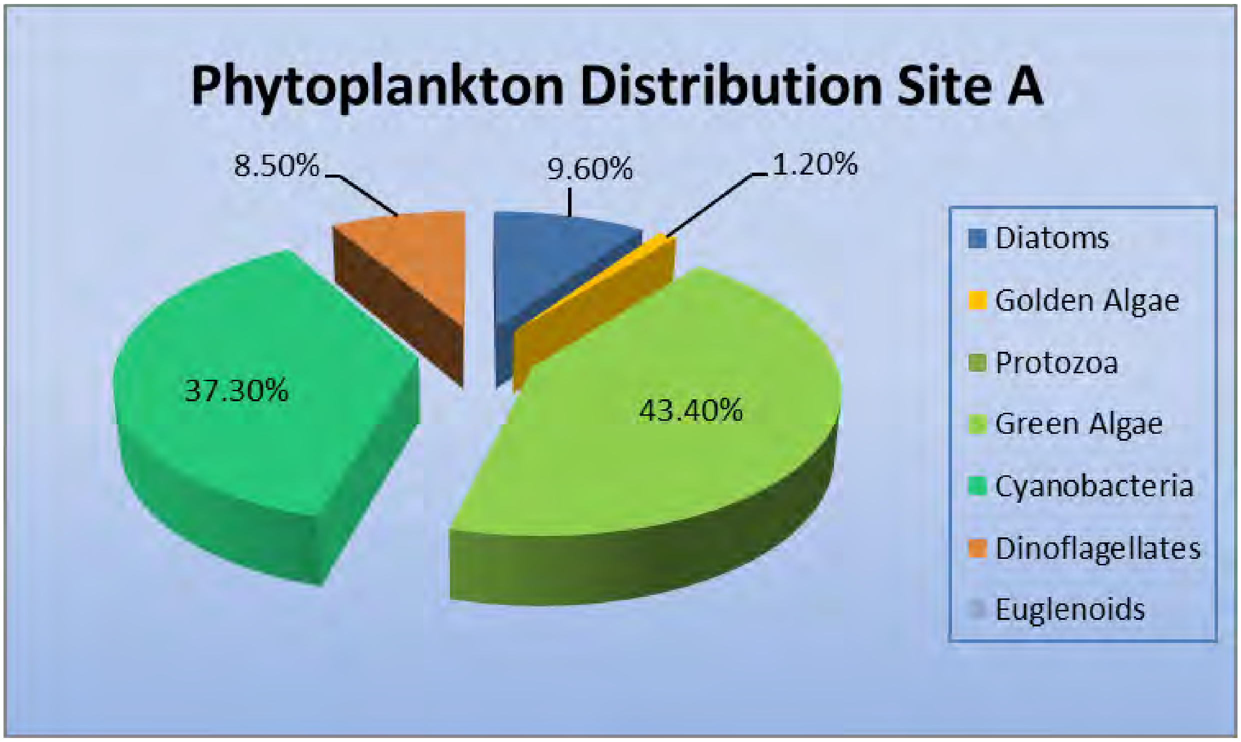

Phytoplankton Distribution Site B
18.40%
21.10%
60.50%
Diatoms
Golden Algae
Protozoa
Green Algae
Cyanobacteria
Dinoflagellates
Euglenoids

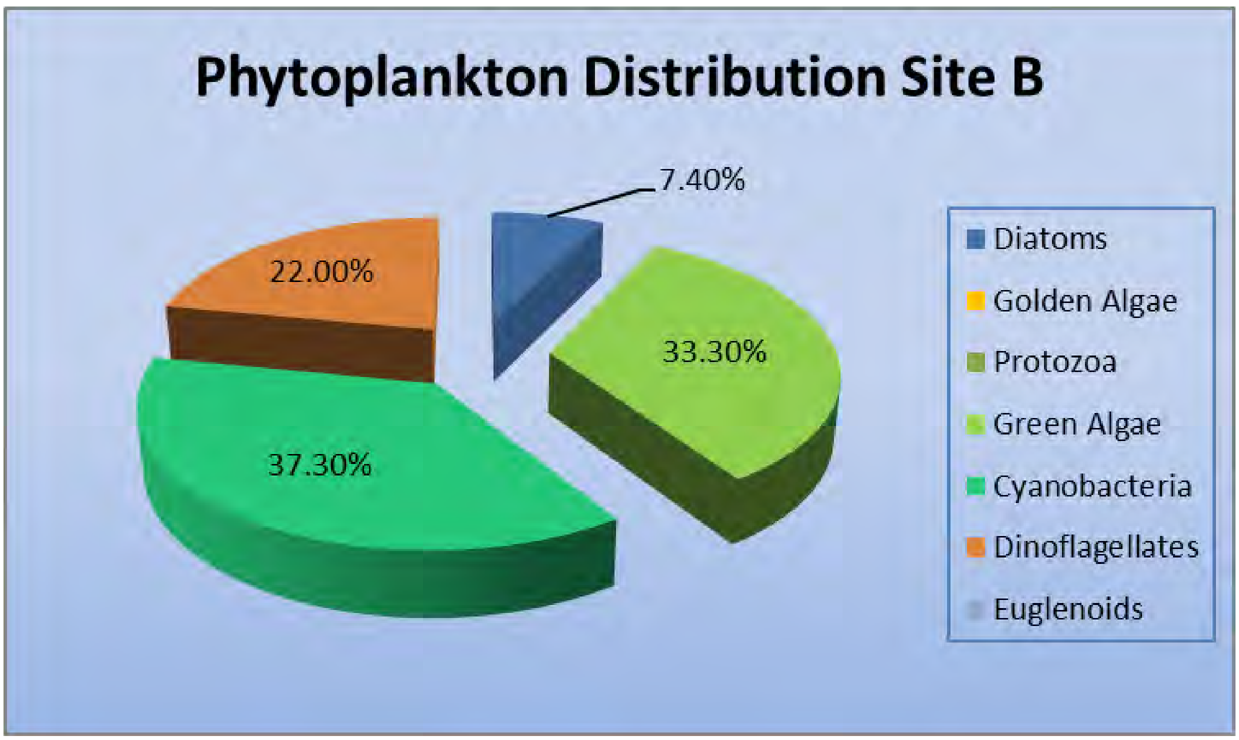
Site A: Inlet Station			Site B: Lake Station			Site C:			Amount Examined: 200mL		
Diatoms	**A**	**B**	**C**	**Green Algae**	**A**	**B**	**C**	**Cyanobacteria**	**A**	**B**	**C**
Asterionella	40	20		*Scenedesmus*	250			*Anabaena*	190	90	
Stephanodiscus	20	10		*Oedogonium*		20		*Aphanizomenon*	120	110	
Fragilaria	20	10		*Staurastrum*	50	90					
				Coelastrum	60	70					
Golden Algae	**A**	**B**	**C**								
Dinobryon	10							**Results**			
								Site	**A**	**B**	**C**
				Euglenoids	**A**	**B**	**C**	**Total Genera**	10	9	
Dinoflagellates	**A**	**B**	**C**					**Water Clarity (ft)**			
Ceratium	70	40						**Organisms/mL**	830	540	

Collection Date: 27 June 2022 **Examination Date: 29 June 2022**

General: Algal diversity and density was moderate indicating a mesotrophic system. It is possible a mild bloom was occurring at the time of sampling.

Inlet Station: The inlet station was dominated by a mixed green algal assemblage comprised of benign genera. Green algae provide benefit to aquatic systems by offering habitat and serving as a food source for aquatic organisms. Under certain conditions, usually attributed to high nutrients and favorable growth conditions like warm water and intense sunlight, green algae can reach nuisance proportion and impede the functionality and uses of a waterbody.
Lake Station: The Lake Station was dominated by two cyanobacteria genera, both of which have the capability of **potentially** producing various toxins. *Anabaena* and *Aphanizomenon* are associated with high Phosphorus and Nitrogen and bloom under favorable growth conditions.

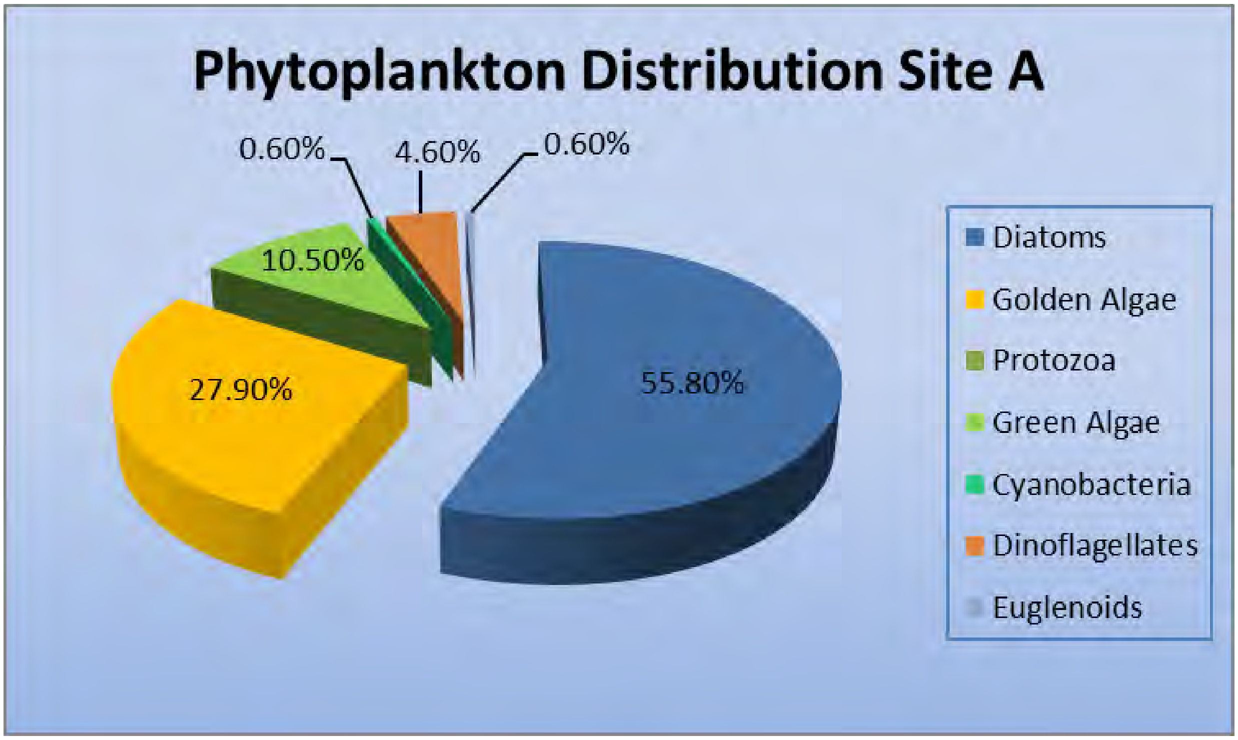

Phytoplankton Distribution Site A
8.50%
9.60%
1.20%
37.30%
43.40%
Diatoms
Golden Algae
Protozoa
Green Algae
Cyanobacteria
Dinoflagellates
Euglenoids

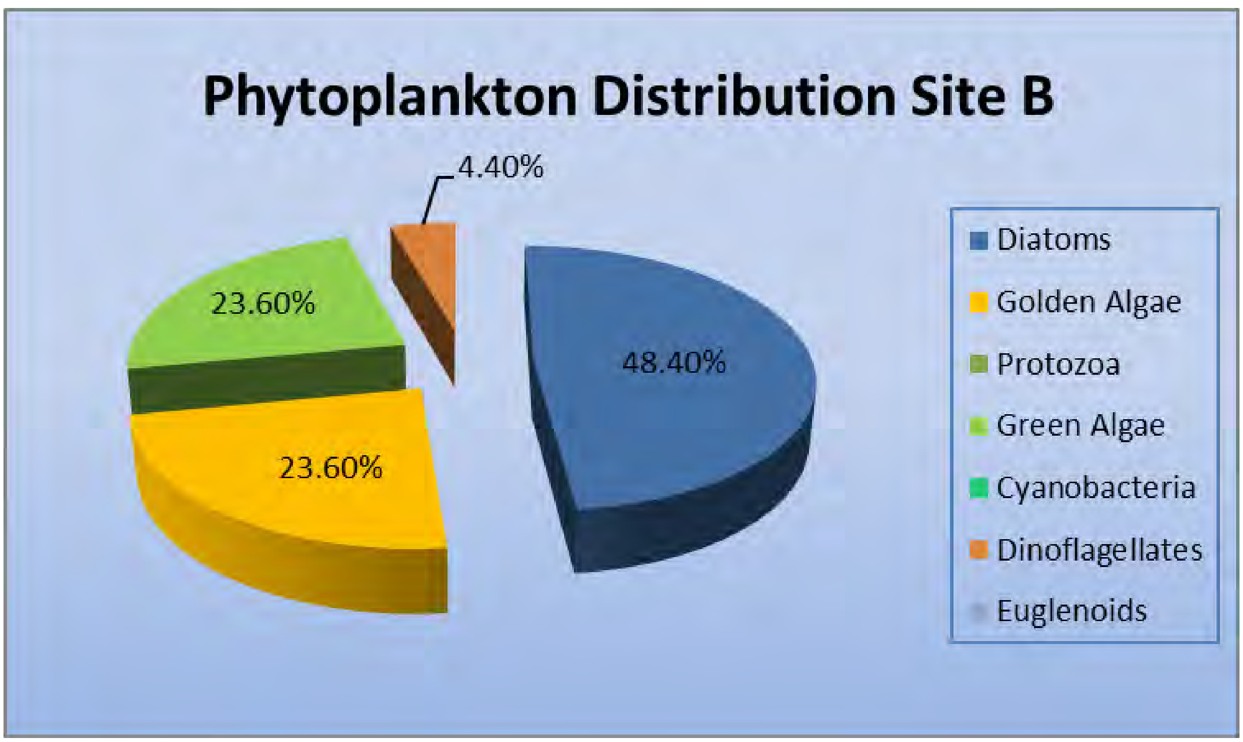

Phytoplankton Distribution Site B
7.40%
22.00%
33.30%
37.30%
Diatoms
Golden Algae
Protozoa
Green Algae
Cyanobacteria
Dinoflagellates
Euglenoids

Site A: Inlet Station			Site B: Lake Station			Site C:			Amount Examined: 200mL		
Diatoms	**A**	**B**	**C**	**Green Algae**	**A**	**B**	**C**	**Cyanobacteria**	**A**	**B**	**C**
Fragilaria	20			*Cosmarium*	50	190		*Microcystis*	10		
Synedra	940	880		*Coelastrum*	80	210					
				Eudorina		10					
				Oedogonium	40	10					
				Staurastrum	10						
Golden Algae	**A**	**B**	**C**	*Scenedesmus*		10					
Dinobryon	20							**Results**			
Mallomonas	20										
Tribonema	440	430						**Site**	**A**	**B**	**C**
				Euglenoids	**A**	**B**	**C**	**Total Genera**	12	9	
Dinoflagellates	**A**	**B**	**C**	*Phacus*	10			**Water Clarity (ft)**	8.0	8.0	
Ceratium		10						**Organisms/mL**	1,720	1,820	
Peridinium	80	70									

Collection Date: 11 August 2022 **Examination Date: 12 August 2022**

Since the last sampling event, algal diversity increased at site A while site B remains the same. Diversity is now considered high at site A while site B is still moderate. The algal density increased at both sites and is now considered high. The assemblage is now dominated by diatoms, specifically *Synedra*. Moderate amounts of green algae and golden algae were reported. Trace amounts of dinoflagellates, euglenoids, and cyanobacteria were also observed. Water clarity decreased and is now considered good.


Phytoplankton Distribution Site A
0.60%
4.60%
0.60%
10.50%
27.90%
55.80%
Diatoms
Golden Algae
Protozoa
Green Algae
Cyanobacteria
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
4.40%
23.60%
23.60%
48.40%
Diatoms
Golden Algae
Protozoa
Green Algae
Cyanobacteria
Dinoflagellates
Euglenoids

APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS

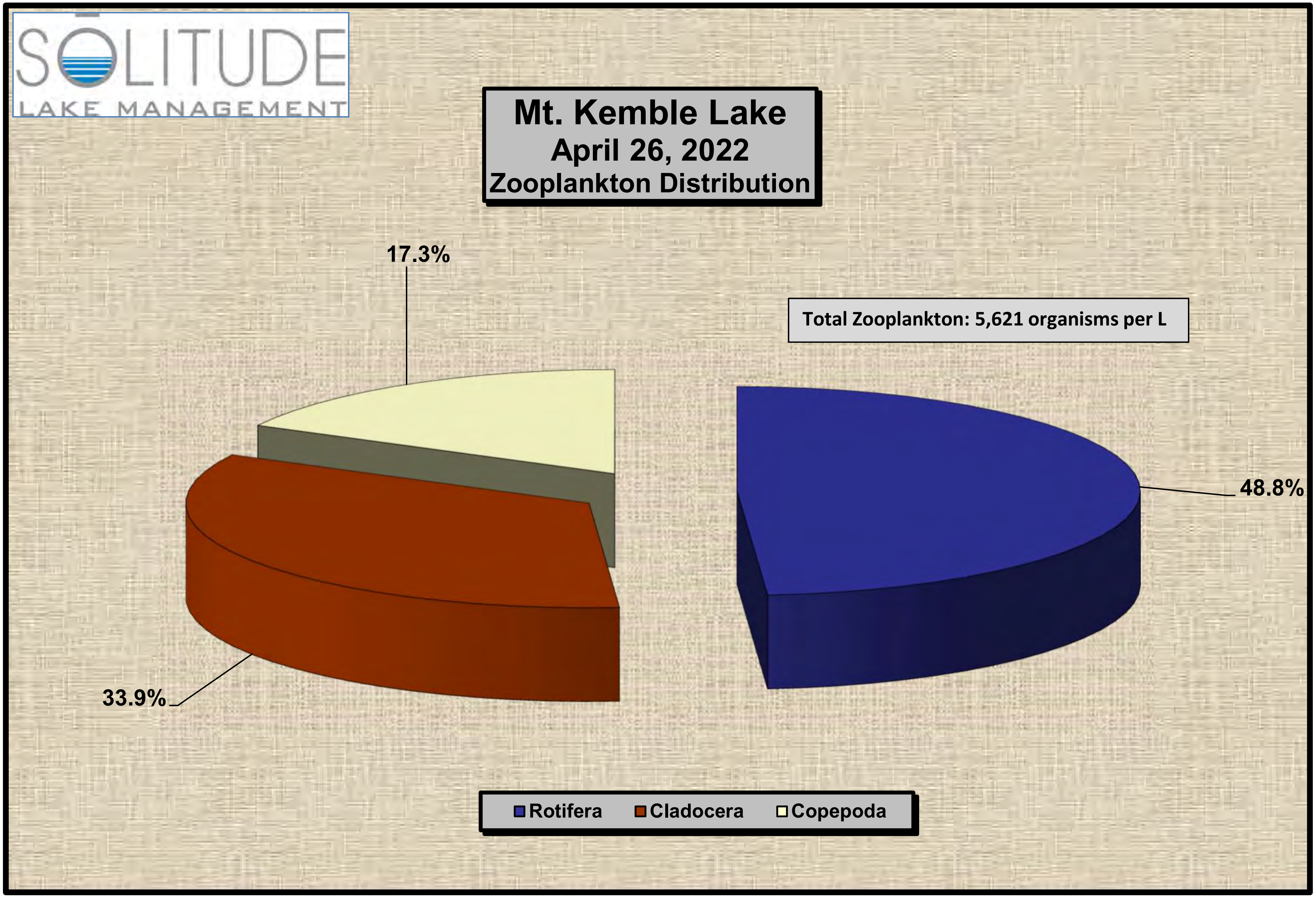
Zooplankton Count Results

SOLITUDE LAKE MANAGEMENT

Site: Mt. Kemble Lake **Date: 4/26/22**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Asplanchnidae	*Asplanchna*	48	162	32	80.67	80667	68.8	1172
		Brachionidae	*Keratella*	33	59	23	38.33	38333	69.8	549
			Brachionus	3	10	2	5.00	5000	69.8	72
			Kellicottia	5	20	6	10.33	10333	68.8	150
		Filinidae	*Filinia*	3	5	1	3.00	3000	68.8	44
		Gastropidae	*Gastropus*	2			0.67	667	68.8	10
		Synchaetidae	*Polyarthra*	1	12	3	5.33	5333	68.8	78
			Synchaeta	8			2.67	2667	68.8	39
	Flosculariaceae	Conochilidae	*Conochilus*	48	57	25	43.33	43333	68.8	630
									Total:	**2743**
Cladocera	**Cladocera**	Bosminidae	*Bosmina*	52	244	28	108.00	108000	68.8	1570
		Daphniidae	*Daphnia*	16	47	6	23.00	23000	68.8	334
									Total:	**1904**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops*	8	44	5	19.00	19000	68.8	276
	Calanoida		*Calanoid nauplius*	22	92	30	48.00	48000	68.8	698
							0.00	0	69.8	0
									Total:	**974**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
5621	2743	48.8%	1904	33.9%	974	17.3%

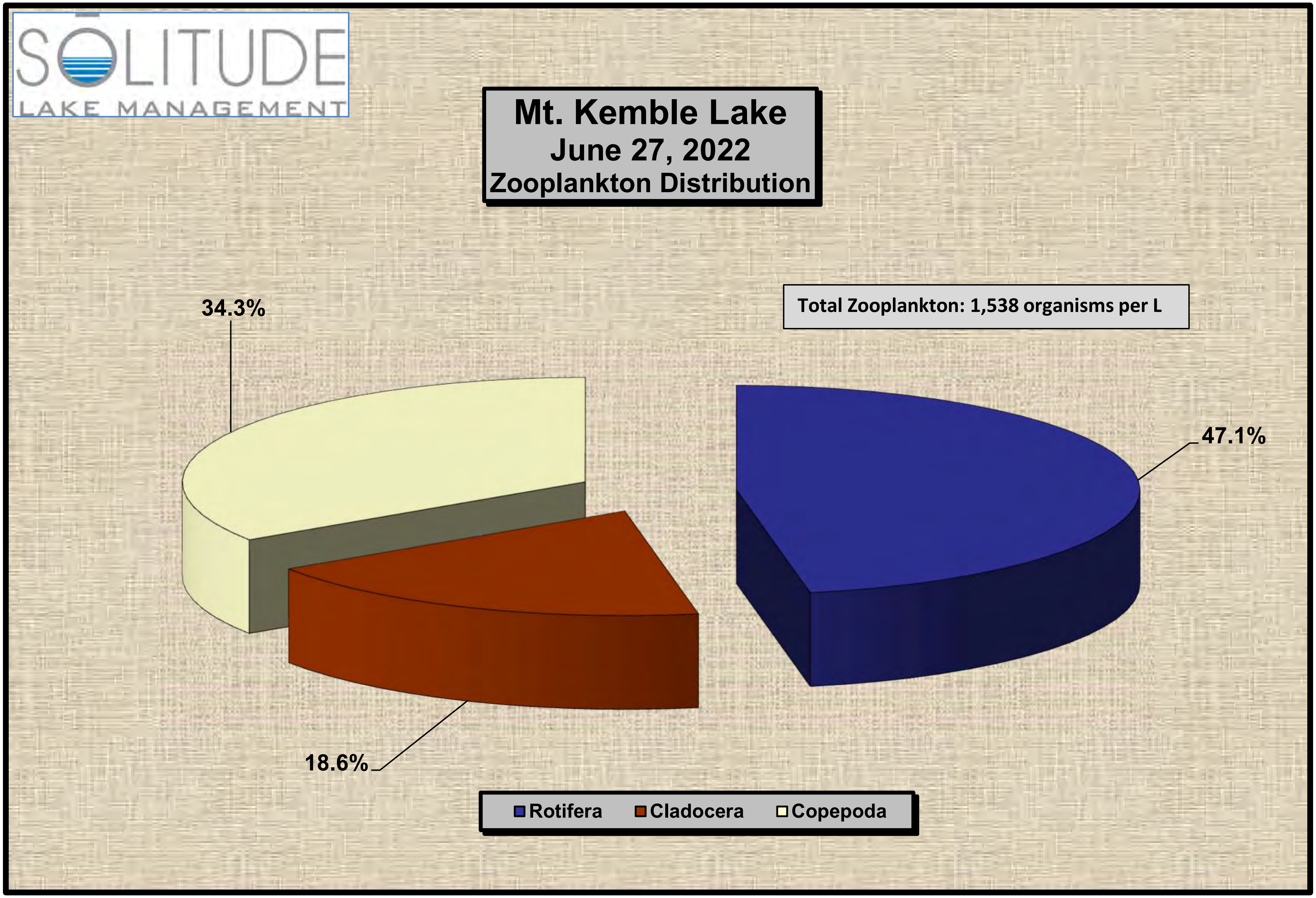

Mt. Kemble Lake
April 26, 2022
Zooplankton Distribution
17.3%
Total Zooplankton: 5,621 organisms per L
48.8%
33.9%
Rotifera
Cladocera
Copepoda

Zooplankton Count Results

Site: **Mt. Kemble Lake** **Date: 6/27/22**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Asplanchnidae	*Asplanchna*	5		7	4.00	4000	68.8	58
		Brachionidae	*Keratella*	20	51	37	36.00	36000	69.8	516
		Lecanidae	*Monostyla*			1	0.33	333	68.8	5
		Synchaetidae	*Polyarthra*	4	4	7	5.00	5000	68.8	73
			Synchaeta		2		0.67	667	68.8	10
		Trichocercidae	*Trichocerca*		3		1.00	1000	68.8	15
	Flosculariaceae	Conochilidae	*Conochilus*	3	4	3	3.33	3333	68.8	48
									Total:	**724**
Cladocera	**Cladocera**	Bosminidae	*Bosmina*	5	10	4	6.33	6333	68.8	92
		Daphniidae	*Daphnia*	5	22	13	13.33	13333	68.8	194
									Total:	**286**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops*	1	8	3	4.00	4000	68.8	58
	Calanoida		*Calanoid nauplius*	18	47	32	32.33	32333	68.8	470
							0.00	0	69.8	0
									Total:	**528**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1538	724	47.1%	286	18.6%	528	34.3%

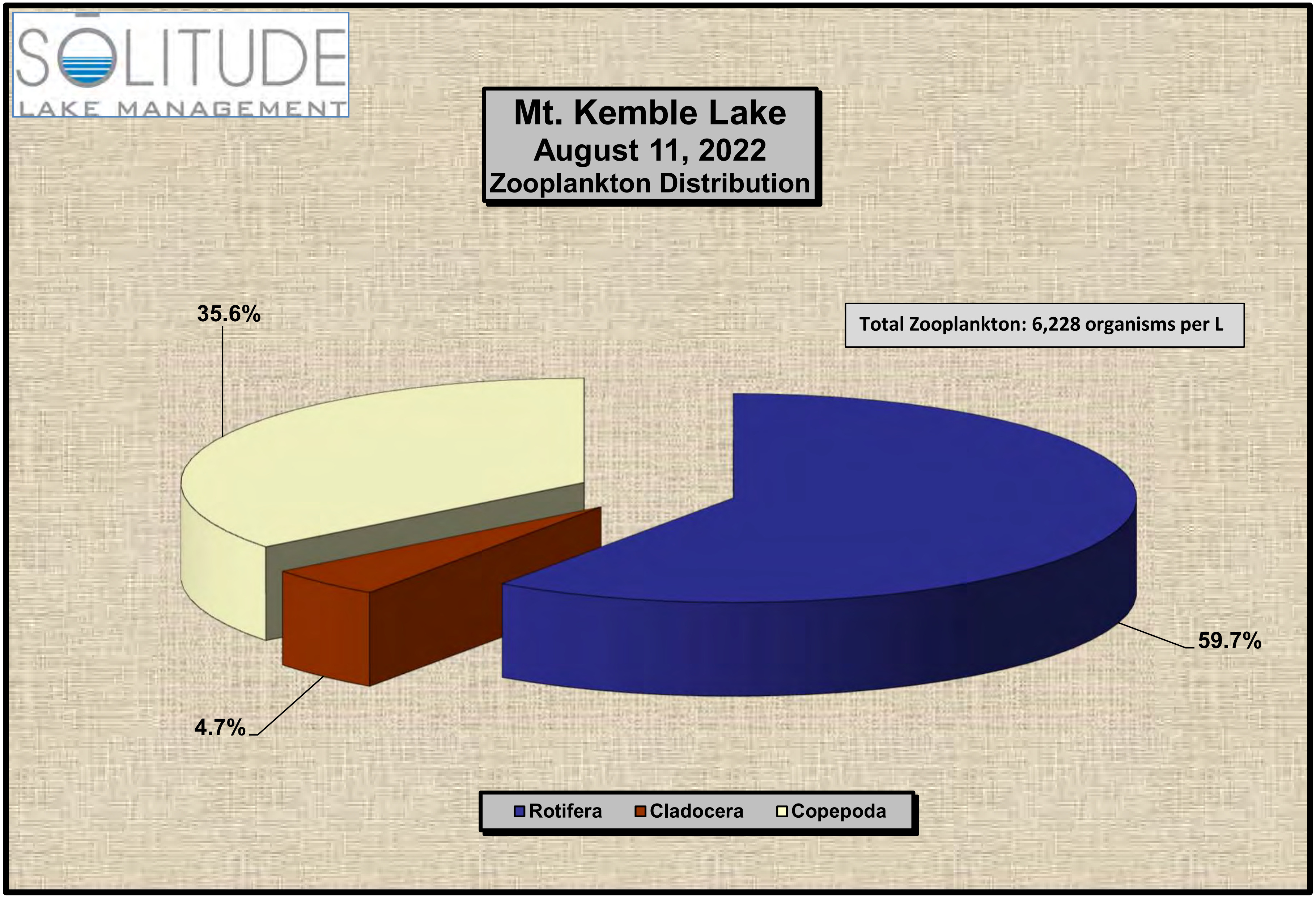

Mt. Kemble Lake
June 27, 2022
Zooplankton Distribution
Total Zooplankton: 1,538 organisms per L
34.3%
47.1%
18.6%
Rotifera
Cladocera
Copepoda

Zooplankton Count Results

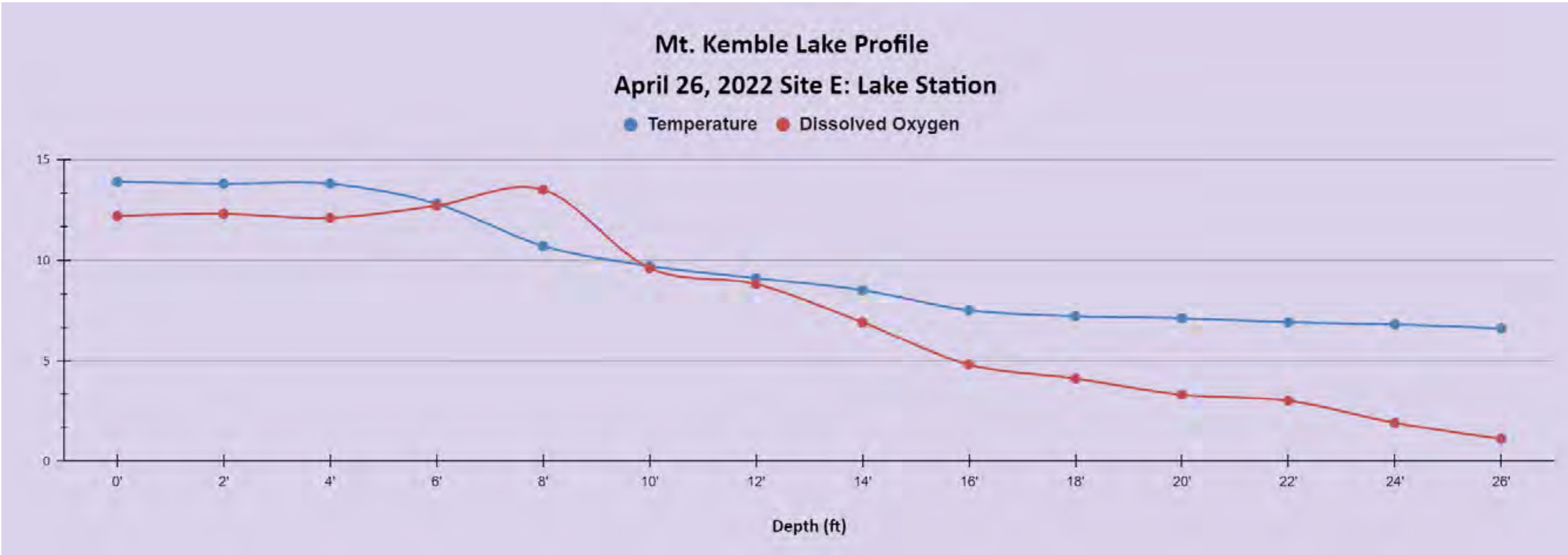
Site: **Mt. Kemble Lake** **Date: 8/11/22**

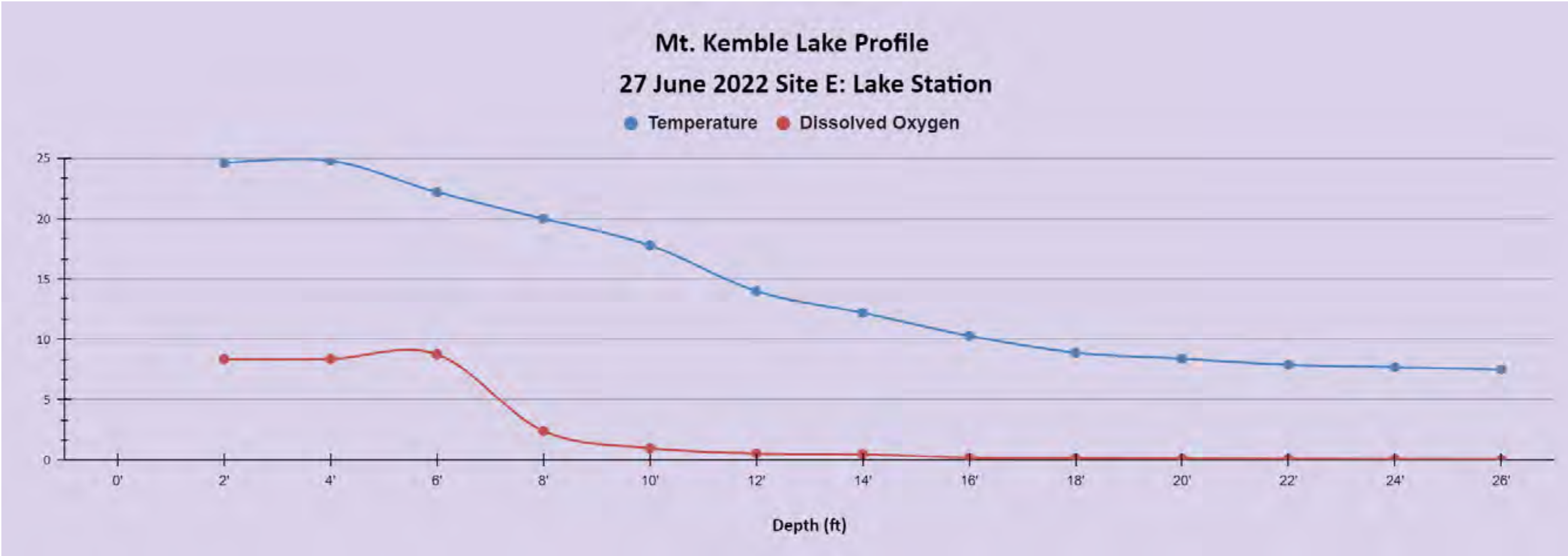
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Asplanchnidae	*Asplanchna*	30	18	18	22.00	22000	68.8	320
		Brachionidae	*Keratella*	71	22	43	45.33	45333	69.8	649
			Brachionus	136	41	71	82.67	82667	69.8	1184
			Kellicottia	97	41	78	72.00	72000	68.8	1047
		Trichocercidae	*Trichocerca*	39	23	27	29.67	29667	68.8	431
	Flosculariaceae	Conochilidae	*Conochilus*	1	4	13	6.00	6000	68.8	87
									Total:	**3719**
Cladocera	**Cladocera**	Bosminidae	*Bosmina*	24	16	21	20.33	20333	68.8	296
							0.00	0	68.8	0
									Total:	**296**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops*	120	86	109	105.00	105000	68.8	1526
	Calanoida		*Calanoid nauplius*	57	35	50	47.33	47333	68.8	688
							0.00	0	69.8	0
									Total:	**2214**

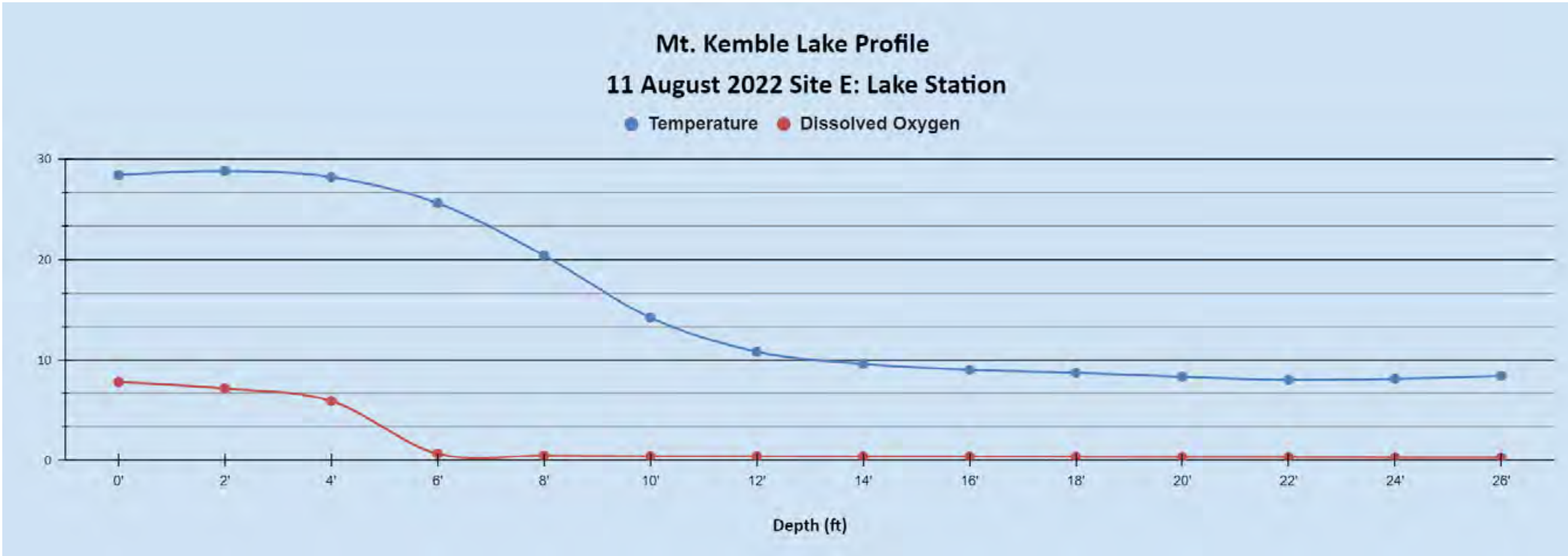
Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
6228	3719	59.7%	296	4.7%	2214	35.6%


SOLITUDE
LAKE MANAGEMENT
Mt. Kemble Lake
August 11, 2022
Zooplankton Distribution
Total Zooplankton: 6,228 organisms per L
35.6%
59.7%
4.7%
Rotifera
Cladocera
Copepoda

APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES




Mt. Kemble Lake Profile
27 June 2022 Site E: Lake Station
Temperature
Dissolved Oxygen
25
20
15
10
5
0
0'
2'
4'
6'
8'
10'
12'
14'
16'
18'
20'
22'
24'
26'
Depth (ft)


Mt. Kemble Lake Profile
11 August 2022 Site E: Lake Station
Temperature
Dissolved Oxygen
30
20
10
0
0'
2'
4'
6'
8'
10'
12'
14'
16'
18'
20'
22'
24'
26'
Depth (ft)